WHY NUCLEAR ENERGY PROGRAMS RARELY LEAD TO PROLIFERATION– NICHOLAS MILLER

ERIN RUST-TIERNEY

WHY IS IT IMPORTANT TO UNDERSTAND THE EFFECTS OF NUCLEAR ENERGY PROGRAMS?

- Nuclear energy has the potential to reduce carbon emissions helping to combat climate change
- Its been argued that the world was in the middle of a nuclear "renaissance" before several nuclear meltdowns in Japan
- Many countries currently exploring nuclear power projects are in unstable security environments

THE CONVENTIONAL WISDOM

- Nuclear programs lead to nuclear weapons
- "It was obvious from the beginning of the nuclear age that nuclear energy for power and nuclear energy for bombs overlapped."
- "The industry required and the technology developed for the realization of atomic weapons are the same industry and same technology"
- "the quickest, cheapest, and least risky route to nuclear weapons."
- "fundamental contradiction between efforts to avoid the proliferation of nuclear weapons and enthusiasm for the spread, for commercial reasons, of nuclear reactors to many developing countries."

CONVENTIONAL WISDOM CONTINUED…

- A nuclear energy program can lead to proliferation in three main ways→ means, motive and political cover
- Means→ scientists will gain the skills and know-how required to produce a bomb which will lower costs
- Motive→ the presence of nuclear technology could prove too tempting to pass up
- Political Cover→ provides plausible deniability for acquiring materials that could be used during the production of a bomb

WHAT IS MILLER ARGUING?

- The conventional wisdom is wrong
- Increased nuclear proficiency does not mean a state will proliferate
- Increased nuclear proficiency actually can prevent proliferation
- Will draw attention from states who have a vested interest in non proliferation
- Create pressure not to proliferate or cause a state to be sanctioned

HOW NUCLEAR ENERGY PROGRAMS RESTRAIN PROLIFERATION

- There are two main restraints to proliferation given the presence of a nuclear program
- Higher likelihood of detection and non proliferation pressure and heightened costs from non proliferation sanctions

HIGHER LIKELIHOOD OF DETECTION AND NON PROLIFERATION PRESSURE

- A state announcing a nuclear energy program always brings attention, especially if the state is not located in a stable security environment
- Once a state announces a nuclear energy program it generally causes other states to begin outside intelligence gathering
- There are three main reasons for this phenomena– all revolving around newly sparked international interest in the given state and the lengths to which it must go to develop a bomb

Table 1. States with Nuclear Energy Programs That Did Not Pursue Nuclear Weapons, 1945–2009

Belgium (1957)	Japan (1960)	Hungary (1974)	Armenia (1991)*
Sweden (1957)	Spain (1964)	Yugoslavia (1975)	Kazakhstan (1991)*
Canada (1958)	Netherlands (1965)	Mexico (1976)	Lithuania (1991)*
Czechoslovakia (1958)	Switzerland (1965)	Philippines (1976)**	Slovenia (1991)*
Italy (1958)	Bulgaria (1970)	Poland (1982)**	Ukraine (1991)*
West Germany (1958)	Finland (1971)	Romania (1982)	Czech Republic (1993)*
East Germany (1960)	Austria (1972)**	Cuba (1983)**	Slovakia (1993)*

NOTE: Year when construction on first power reactor begun (or when reactor inherited at independence) appears in parentheses.

*Inherited power reactors at independence rather than constructing them.

**Construction on power reactors never completed/reactors never became operational.

Table 2. Nuclear Energy Programs and Pursuit, 1954–2009

No Energy Program during Pursuit	Energy Program during Pursuit	Energy Program Predated Pursuit	Power Reactor Operating before Pursuit
Australia	Argentina	Argentina	Argentina
China	Brazil	Brazil	
Egypt	France	India	
Iraq	India	Iran	
Israel	Iran	Pakistan	
Libya	North Korea*		
Syria	Pakistan		
	South Africa		
	South Korea		
	Taiwan		

*North Korea briefly had light water power reactors under construction in the early 2000s as part of the Agreed Framework.

WHAT DOES THIS MEAN?

- Table 1 has 28 total states that had a nuclear energy program but made no strides to proliferate
- Table 1 also shows that multiple states located in unstable security environments never attempted to proliferate→ Cuba, Finland, both Germanys, Japan, Sweden and Ukraine
- Four countries on the list in Table 1 explored the possibilities of a weapon but both Way's coding and Miller rate "exploration" as lower level of proliferation activity than pursuit of a bomb

WHAT DOES IT MEAN…? CONTINUED

- Table 2 lists states that have attempted to proliferate since 1954– when the Soviet Union connected its first nuclear power grid
- Shows that more states pursue a weapons program in the presence of a nuclear energy program than without one
- Five countries' energy programs predated their weapons programs
- In another five countries the weapons program predated the energy program

Table 3. Nuclear Energy Programs and the Probability of Pursuit, 1954–2000

	Annual Probability of Pursuit	Number of Observations
No power reactor operating	0.25%	5,606
Power reactor operating	0.17%	592

P-value from a chi-square test assessing the difference across the two groups: 0.70.

Table 4. Nuclear Energy Programs and the Probability of Pursuit, 1954–2000

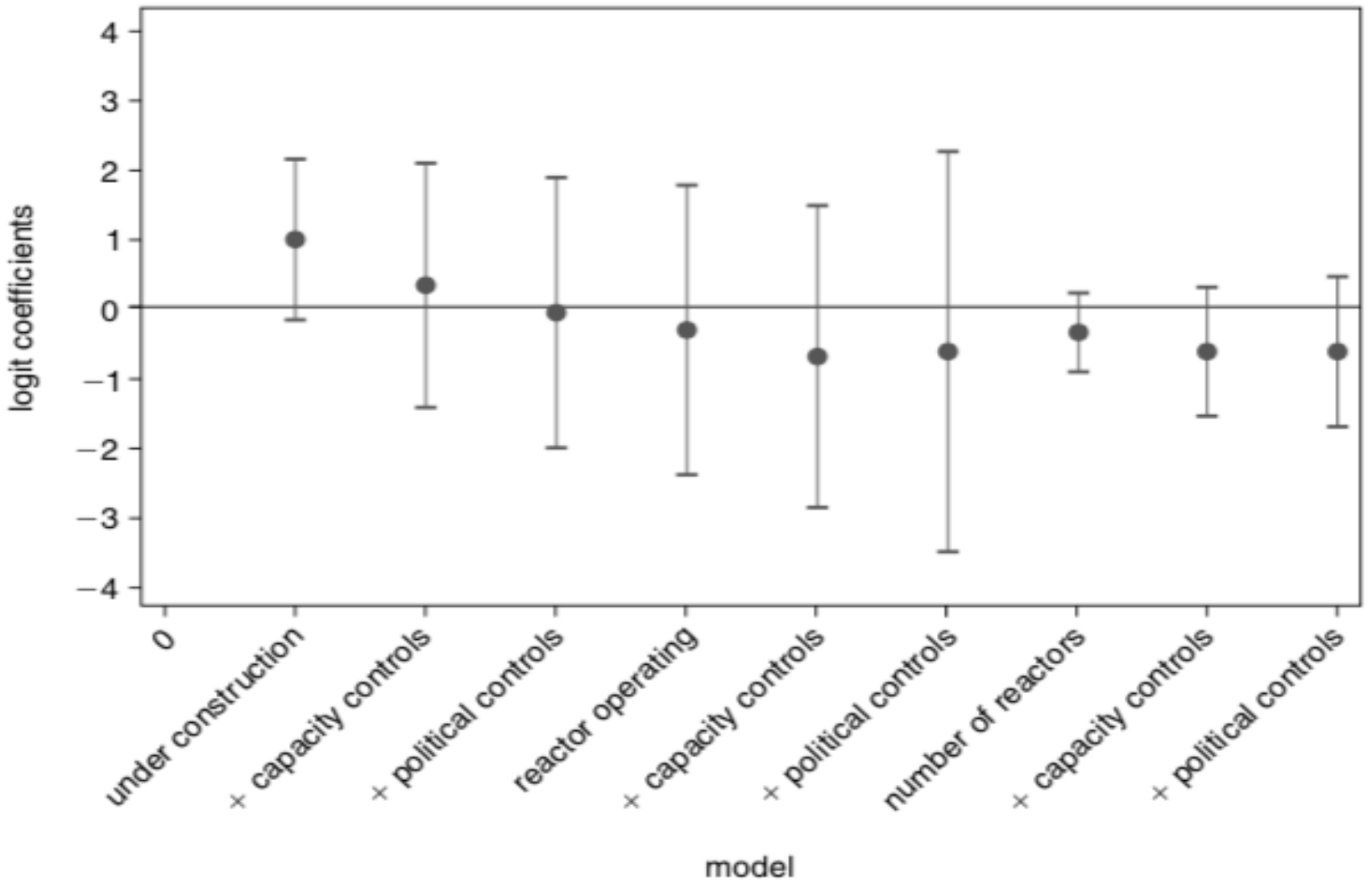
	Annual Probability of Pursuit	Number of Observations
No power reactor operating or under construction	0.20%	5,418
Power reactor operating or under construction	0.51%	780

P-value from a chi-square test assessing the difference across the two groups: 0.10.

PROBABILITIES

- Compares the rate at which states attempt to proliferate annually between 1954 and 2000 depending on whether they do or do not have a nuclear energy program
- If there was a strong correlation between the presence of an energy program and proliferation there would be a stark difference in the two probabilities
- The results of table four are more in line with the conventional wisdom

Figure 1. Nuclear Energy Programs and the Odds of Pursuit



EXPLAINING THE MODELS

- These models control for potential confounding variables like wealth of the country to avoid bias
- In seven of the nine models the coefficient on the variables measuring nuclear energy programs is negative
- None of models have a coefficient distinguishable from zero beyond a 95% confidence level

Table 5. Nuclear Energy Programs and Nuclear Weapons Acquisition, 1954–Present

	Did Not Acquire Nuclear Weapons	Acquired Nuclear Weapons	% Acquired
No energy program	Australia, Egypt, Iraq, Libya, Syria	China, Israel, North Korea	3/8 (37.5%)
Energy program	Argentina, Brazil, Iran, South Korea, Taiwan	France, India, Pakistan, South Africa	4/9 (44%)

EXPLAINING THE LAST CHART

- Table 5 shows that countries that pursued a nuclear weapons program while they already had an energy program were only marginally more likely to acquire nuclear weapons
- But if you code North Korea as a country with an energy program it brings the rate at which countries with energy programs produce nuclear bombs to 50% compared to 28.5% of those without

HEIGHTENED COSTS FROM NON PROLIFERATION TREATIES

- Evidence suggests that the threats of sanctions helped to curb Japan, Sweden, Taiwan and South Korea's nuclear weapons ambitions
- These are easy cases to make the argument for sanctions because all four states are allied to the US and thus would be more receptive to the threat of sanctions

POTENTIAL ISSUES WITH THE ANALYSIS

- No guarantee that these trends will continue
- Over-aggregating different time periods may bias the article's quantitative findings
- Selection effects bias
- Widespread nuclear latency